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RADIO SPECTRA AND NVSS MAPS OF DECAMETRIC SOURCES

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Abstract. We constructed radio spectra for ~ 1400 UTR-2 sources and find that 46% of them have concave curvature. Inspection of NVSS maps of 700 UTR sources suggests that half of all UTR sources are either blends of two or more sources or have an ultra-steep spectrum (USS). The fraction of compact USS sources in UTR may be near 10%. Using NVSS and the Digitized Sky Survey(s) we expect to double the UTR optical identification rate from currently $\sim 19\%$.

The UTR-2 catalogue (hereafter “UTR”) of 1754 radio sources [2] covers $\sim 30\%$ of the sky ($\delta_{50} = [-13^\circ \dots +20^\circ; +41^\circ \dots +60^\circ]$) at $\nu = 10\text{--}25$ MHz and angular resolution $\theta_{\text{RA}} \times \theta_\delta = 40' \times 40''/\sec(\delta - 49.7^\circ)$ at 16.7 MHz. We intend to improve the optical identification (ID) fraction (of now $\sim 19\%$) for this lowest-frequency source sample presently available, in order to look for new or rare species of sources.

To construct radio spectra of UTR sources we used “CATS”[1] to extract all 6C, MIYUN, B3, MSL, TXS, MRC, WB92, PMN, 87GB and GB6 sources within $40'$ from the UTR location. The “raw” spectra given by these fluxes were refined using computer charts of source locations around UTR positions. All counterparts from TXS, GB6 and PMN within circles of $1'$ radius were considered one source. Groups of sources lying further apart were assigned separate spectra, each with the UTR flux as upper limit. We fitted spectra of 1525 radio counterparts to 1401 UTR sources with either straight (S), convex (C^-), or concave (C^+) curves in the $\lg \nu - \lg S$ plot. We found 47/46/7% of type S/ C^+ / C^- , while other authors found partitions of 46/5/39%, 23/6/42%, and 22/6/25% respectively, at decametric [8], intermediate [4], and high frequencies [5]. The high fraction of C^+ spectra in UTR sources may be partly intrinsic due to source selection at very low ν , and partly be caused by blends of steep- and flat-spectrum sources in one UTR beam.

We inspected 1.5 GHz maps of the NVSS [3] for ~ 700 UTR sources with $\text{RA} < 8^{\text{h}}$. The maps were $72' - 134'$ on a side, depending on UTR positional errors and HPBW at 16.7 MHz. 16% of the maps were not useful due to significant holes in coverage. No dominant source was seen in the innermost half of 66% of the useful maps, suggesting that (a) the decametric flux may be a blend of unrelated sources within the UTR beam or that (b) the UTR source may be faint at 1.5 GHz due to a steep spectrum. Apart from many complex Galactic plane sources the NVSS maps revealed a few examples of previously unknown, radio- and optically-faint, and very extended ($10' \lesssim \text{LAS} \lesssim 18'$) FR I type radio galaxies, some at low galactic latitude.

We had useful NVSS maps for 43 UTR sources without a radio counterpart listed in [2]. 40 of these lack a dominant NVSS source, i.e. the UTR signal may be a blend of unrelated sources. One of the other 3 is a USS cD galaxy (A193, $\alpha=2.8$, $S \sim \nu^{-\alpha}$), thus we plan to look for USS sources among the 40 former ones as well.

There are 90 UTR sources identified with 92 PKS sources in [2], 42 of which without optical ID. Today only 3 more optical IDs are known from [9] or NED. Of the 19 NVSS maps we had for the 42 unidentified UTR-PKS sources, only 3 showed a dominant 1.5 GHz source, again suggesting confusion in the UTR catalogue.

We looked for UTR objects in two USS samples with VLA maps. One set [6] (4C sources with $|\delta_{50}| < 4^{\circ}$, $\alpha_{365}^{178} > 0.9$ and $\text{LASTXS} < 30''$) should be near or above the UTR limit, but out of 146 UTR-4C associations with $|\delta_{50}| < 4^{\circ}$ listed in [2], only 29 coincide with objects from [6]. This may be due to a combination of (a) source sizes $> 30''$; (b) sources near the 4C limit being missed by UTR; (c) spectral flattening below ~ 100 MHz (as observed in compact steep-spectrum sources) or (d) TXS having lost some flux from these extended sources, implying a spectrum flatter than assumed by [6]. The other published USS sample [7] has ~ 350 sources in the UTR region. Among the 44 safe coincidences with UTR radio counterparts we find a lower fraction of point sources and more doubles (7% and 75%) compared to 24% resp. 58% in the full sample of 350 USS sources.

26% of the NVSS maps of the UTR sources without optical ID in [2] show one (or occasionally two) sources dominating the field. If these are the true IDs and optically bright enough, we may hope to raise the ID rate of UTR sources to $\sim 40\%$ using only NVSS, FIRST and the Digitized Sky Survey(s).

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